UNIVERSITY OF PENNSYLVANIA

A STUDY

OF

THE ADEQUACY OF EXISTING PROGRAMS FOR THE TRAINING OF JOURNEYMEN MOLDERS IN THE IRON AND STEEL FOUNDRIES OF PHILADELPHIA

ALFRED HECTOR WILLIAMS

A THESIS

IN ECONOMICS

PRESENTED TO THE FACULTY OF THE GRADUATE SCHOOL IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

PHILADELPHIA

1924

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INTRODUCTION

Purpose and Scope of the Study

Throughout the United States, the apprenticeship method of training craftsmen in the foundry industry has broken down. This is attested by the efforts of national and local manufacturers' associations, trade publications, the journal of organized foundry labor, and individual foundrymen to stimulate apprenticeship or create a substitute for it. The decline and the recognition of it are not of recent origin. J. H. Ashworth states that during the seventies the Iron Molders' Union took steps to protect apprenticeship by legislating against the helper system of acquiring trade skill.[1] A stove manufacturer of Troy, N. Y., is quoted in the *International Molders Journal* for May, 1877 as saying, "I do not use the term apprentices for the reason that none exist in our trade, nor have they ever existed within my remembrance."[2] Many causes have been assigned to the failure of foundry apprenticeship and just as numerous have been the proposals for rehabilitation. However, despite the early origin of the problem and the consequent opportunity for study and experimentation, the situation is more acute to-day than it ever was.

In Philadelphia the nature of the industry renders the problems created by the decline particularly severe. Philadelphia foundrymen are not unaware of this. The Metal Manufacturers' Association, which unites the important foundries of the city, has since its origin in 1905 stressed the importance of foundry apprenticeship in the annual reports of the Secretary and President. In February, 1914, it formed an apprenticeship committee which has continued to function in an effort to arouse interest in foundry training.

Because of the acuteness of the problem in Philadelphia, it was believed that a study was justified and the results are here presented. The procedure used in making the study was as follows:

(1) A census was taken of the number of workers employed as

[1] Ashworth—"The Helper and American Trade Unions," p. 35.
[2] Ibid., p. 327.

of December, 1923, in the several occupations in the foundry. The data covered twenty-four of forty-two active foundries in the city and represented approximately seventy-six per cent. (76%) of the foundry workers employed at that time. A similar count of employees was secured from thirty-three suburban plants.

(2) By means of personal conferences with responsible members of the foundry managements, a study was made of the nature of the training being given to those who were reported as being in training. Thirty-two of the forty-two active plants and one inactive plant in the city as well as five suburban plants, were visited for this purpose. The city foundries visited employed eighty-five per cent. (85%) of the foundry workers in the community.

(3) A study of the adequacy of existing training programs, both as to numbers and as to content, was made. This last phase was approached historically through the literature on foundry apprenticeship. This was found in the files of *The Foundry, Transactions of the American Foundrymen's Association, International Molders Journal, Iron Trade Review, Castings and Open Shop Review.* In reviewing these publications especial attention was given to the records of conferences and agreements between foundrymen and the union on the subject of the ratio of apprentices to journeymen. The more general treatises on apprenticeship and industrial training, as listed in the appended bibliography were also consulted. The opinions of the Philadelphia foundrymen as to present and proposed training methods were recorded and considered. Correspondence, supplemented by interviews when feasible, was carried on with trade school authorities, officials of the International Molders' Union of North America, local and national foundrymen's associations, state officials, and others prominent in the industry.

(4) These lines of inquiry seemed to justify certain conclusions, which are presented in this study.

Acknowledgment is made of the counsel and direct assistance of the Metal Manufacturers' Association of Philadelphia. The questionnaire was sent out under its auspices. The Association furnished over the signature of Secretary Earl S. Sparks, a letter of introduction without which it would have been impossible to make contact with many of the plants.

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CHAPTER I

Definition of the Foundry Industry

The foundry industry, in the broadest sense of the term, embraces the manufacture of articles of iron and steel and non-ferrous metals by means of a process known as casting. Other methods of forming objects of metal with which the casting process should be compared are hammering, pressing and rolling. Casting differs essentially from the other operations in that it requires no mechanical working of the metal to produce the finished shape, the process consisting only of the pouring of the molten metal into a cavity or mold of final form. The shop where metals are cast is called a foundry.

It is customary to work with only one kind of metal in a shop. Thus a foundry working with iron does not usually produce brass castings also; likewise, a steel foundry does not turn out aluminum castings. The principal types of foundries in a classification according to metals used are iron, steel, brass, and aluminum. Foundries casting ferrous metals employ ninety-two and two tenths per cent (92.2%) of the wage earners in all foundries. This study deals only with foundries casting products of ferrous metals.

The major processes in a foundry are:

(1) Preparing the form or mold;

(2) Melting the materials which constitute the metal; and

(3) Pouring the metal into the mold.

The mold or cavity is usually made in sand or loam by the use of a pattern which is a model, in wood or metal, of the finished article. The pattern is in two parts—the upper or cope part and the lower or drag part. The process, in brief, consists in placing the pattern part in a boxlike container called a "flask" and packing sand around it so that when it is withdrawn there is a cavity of the desired shape. When the article to be cast is exceptionally large it is sometimes made without the use of the flask.

In an iron foundry the metal is usually melted in a heating furnace known as a "cupola." Pig iron and scrap iron, together with coke or anthracite coal for fuel and limestone for flux, make up the charge that is put into the furnace. In a steel foundry the melting takes place in an open-hearth or Bessemer furnace and the ingredients of the charge are those usually employed in steel manufacture.

When the metal in the furnace has reached a proper state of fluidity it is drawn off into ladles and transported to the molds into which it is poured. The casting, after solidifying, is taken from the sand—a duplicate of the pattern. Finally, adhering sand and excess metal are removed by cleaning operations.

Molding operations may be classified from several standpoints. According to the size of the casting there are:

Bench molding which is performed at a work table and confined to molds ranging up to about fifty pounds in weight. The bench, or work table, is about waist high and eliminates a stooping posture.

Floor molding includes all work that is too large for a bench; it is subdivided into light floor molding where the castings range up to about 1500 pounds in weight, and heavy floor molding for castings above 1500 pounds. A hand or electrically operated crane is usually employed to handle the completed mold and casting.

Classified according to the material in which the mold is made, the principal types of molding are:

Green sand work in which ordinary molding sand that has not been subjected to heat treatment is used;

Dry sand work in which the sand, after it is in final form, is baked in an oven for the purpose of giving it a hard surface and fixing its shape permanently;

Loam molding which consists in constructing a brick mold the surface of which is coated with a sand and clay mixture and then baked.

Still another classification is *hand work* or *machine work* according to the use or non-use of a machine. Machines are operated by hand or by mechanical power and perform one or more of the

following operations: packing the sand, turning over the mold to permit the pattern to be withdrawn, and withdrawing the pattern.

The foundries, like molding operations, fall into different classifications according to different points of view. The shop known to the trade as the *heavy machinery foundry* is a heavy floor work shop attached to an establishment whose product is something other than castings as such. Heavy pieces weighing above 500 pounds are commonly produced and bench work is negligible. The *light machinery foundry* is likewise operated by a company whose product is made only in part of castings. Bench and light floor work rather than heavy floor work distinguish it from the heavy machinery foundry. The *light jobbing* foundry is one which does a custom business with the general trade in bench and light floor castings. The *heavy jobbing shop* is equipped to do a jobbing business of the poundage mentioned above for heavy floor work. It should be noted that the machinery foundries often engage in jobbing work of the class for which they are equipped when they are not supplied with enough work by their own companies to utilize their full capacities. The *stove-shop* specializes for the most part in the production of castings which are used in the manufacture of stoves. Foundries of this type form a separate branch of the trade. There are other plants which confine themselves to the manufacture of one type of product such as cast iron pipe, radiators, or sash weights.

CHAPTER II

Importance and Nature of the Industry in Philadelphia

In estimating the importance of the foundry industry for the country as a whole or the relative importance in the trade of a particular city, it is not possible to use the methods of appraisal commonly employed for manufacturing industries; that is, judging according to value of products, capital employed, cost of materials, value added by manufacture, and number of wage earners. The reports of the Census of Manufactures issued by the Federal Bureau of Census combine foundry and machine shop products in such a way as to make it impossible to segregate information which pertains only to foundries. Where foundries are departments of larger establishments data are given for the entire establishment. In Philadelphia, eighteen of the forty-two foundries are so connected and for these the above information is accordingly not obtainable.

However, the reports of the Census of Population for 1910 and 1920 present occupation statistics which make it possible to secure the number of "iron molders, founders, and casters" for the country and for individual cities and this information is used in determining the rank of Philadelphia.* The schedule of instructions used by the Census authorities in grouping returns (attached as Appendix A) shows that, under the above heading, forty-two occupations comprising all designations likely to be used, make up the group. Included in the list is the term "foundry hand," under which the census takers probably listed most of the individuals engaged in foundry occupations other than molding.

* Data according to cities, are not given in census reports prior to 1910.

TABLE No. 1

NUMBER OF IRON MOLDERS, FOUNDERS, AND CASTERS IN SEVEN LEADING FOUNDRY CITIES OF UNITED STATES ACCORDING TO U. S. CENSUS OF 1910 AND 1920

City	*1910*	*1920*
Chicago	6,356	5,796
Cleveland	3,531	3,945
Detroit	2,878	3,760
Milwaukee	2,460	2,410
Philadelphia	*2,510*	*2,064*
Buffalo	2,141	2,017
St. Louis	1,969	1,946
UNITED STATES	112,122	114,031

Philadelphia is shown by the foregoing table to be a city of major importance in the industry. The table also shows that the only change in the relative ranking of the cities listed was the decline of Philadelphia from fourth position in 1910 to fifth position in 1920 and a corresponding advance by Milwaukee from fifth place to fourth place during the same period. It is interesting and significant to note that every city but two, Cleveland and Detroit, registered an absolute loss in number of molders and that the two exceptions made substantial gains. The losses were due in part to the general increase in the use of molding machines with their increased production per man, and the gains to the importance in Cleveland and Detroit of the automobile industry, which consumes so many castings, and which has taken such phenomenal strides forward in the last decade.

Foundry work in Philadelphia is, for the most part, of a jobbing nature. That is to say, the castings manufactured in most of the shops are diversified in form and produced on special order in small lots. This is in contrast to conditions which obtain in such areas as Connecticut, Detroit, and Cleveland. Connecticut is a region manufacturing small hardware and tools. These products are usually turned out in quantities sufficient to make the work, in the parlance of the trade, a "specialty job." Detroit and Cleveland, largely because of the automobile industry, likewise have repetition work.

Because of the miscellaneous nature of the work in Philadelphia, skilled general "all around" molders predominate. Seldom does

a foundry produce the same kind of castings in sufficient quantity to permit it to adopt quantity production methods which involve the use of special equipment and specialty molders. The molders must be skilled in a wide range of work to enable them to handle the variety of castings which the jobbing shop, in an industrial city of the size and diversity of Philadelphia, is called upon to make. In the centers just mentioned, the specialty or repetition work is usually turned out on molding machines, the operators of which are apt to be skilled only in operating one type of machine and sometimes only on one job. Even when a machine is not used, a specialty hand molder skilled on one class of work is apt to be employed. A correspondent whose duties bring him in touch with the foundry industry of Michigan commented as follows on the skill of the molders working in quantity production shops: "In regard to our larger production foundries in the state engaged in the automobile industry, it is safe to say that they do not need molders. The sort of help they want is the strong man who can be trained to operate a machine successfully." Another correspondent in an important center of automobile manufacture said: "We do not know of any foundry which has a comprehensive plan for training apprentices. This probably is due to the fact that most of the foundries are production shops and that the work is done not by high skilled molders, but by handymen who are trained as specialists."

But, there is almost no quantity production in Philadelphia—a fact which reflects itself not only in a demand for more highly skilled labor, but also in a low investment of capital in special equipment for the transportation of materials and tools, the pouring of iron, the mixing of sand and other operations which characterize quantity production. In fact, only three of the foundries can lay any claim at all to the term "production shop."

Another consequence of the jobbing nature of the business, is the small size of the foundries. The returns of the census of workers presented in the following section of this paper show that the number of workers per shop is fifty-three and that the largest shop in the group employ only 211. On the other hand, it is not uncommon in the large production shops of other centers for the molders alone to number several hundred.

The combination machinery and jobbing shop is characteristic of the Philadelphia industry. Only four machinery shops were found that are not engaged in jobbing work. It is doubtful if this practice exists to the same extent elsewhere—certainly not in the automobile or hardware foundries, where the entire scheme of production hinges upon quantity orders rather than upon calls for only a few of the same kind of castings, and where it is possible to reduce the cost of production by employing molders who are machine operators only and therefore incapable of handling a miscellaneous run of jobbing work.

If we include the combination machinery and jobbing shop with the strictly jobbing shops, it can be said that seventy-six per cent. (76%) of the foundries in Philadelphia do a jobbing business.

A classification of the foundries of the city according to type of work gives the following result:

TABLE No. 2

PHILADELPHIA FOUNDRIES CLASSIFIED ACCORDING TO TYPE OF WORK

Type	*Number*	*Per Cent of Total Number*
Light Jobbing	12	28.6
Heavy Jobbing	6	14.3
Light Machinery	10	23.8
Heavy Machinery	8	19.
Stove	4	9.5
Sash-weight	2	4.7

This table shows clearly the predominance of machinery and jobbing shops. Stove foundries are shown to be of minor importance in the industry of the city. One of the four stove shops listed is very small and engaged only on repair work; if this shop were eliminated the importance of stove founding would be further decreased. Only two of the Philadelphia foundries produce steel castings, the requirements of the city for this class of work being met in large part by suburban plants.

In the territory adjacent to the city there is a rather marked segregation of steel foundries in Chester and of stove and of heater shops north of Philadelphia in such towns as Lansdale, Hatboro and Collegeville.

CHAPTER III

Census of Workers in Philadelphia Foundries

The number of workers in the different foundries in Philadelphia was secured from a questionnaire* sent for the purpose of this study. The average number of workers employed, in the occupa-

TABL

Census of Foundry Workers in Twenty-four Philadelphia Foundr

Occupation *Firm Number*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	
Light floor molders	8	7	8	4	1	8	3	31	
Light floor helpers	..	..	..	1	..	8	..	..	
Light floor trainees	4	4	..	..	..	..	..	4	
Heavy floor molders	4	6	4	..	13	2	..	..	
Heavy floor helpers	1	7	4	..	..	2	..	..	
Heavy floor trainees	2	2	..	..	..	..	..	..	
Loam molders	..	..	..	..	..	1	..	..	
Loam helpers	..	..	..	..	..	1	..	..	
Loam trainees	..	..	..	..	..	..	..	..	
Bench molders	10	6	5	5	2	1	5	1	
Bench helpers	..	..	1	..	..	..	..	..	
Bench trainees	2	1	..	..	..	..	..	..	
Molding machine operators	1	18	5	1	..	..	6	1	
Molding machine helpers	1	8	1	1	..	..	..	..	
Molding machine trainees	3	15	..	..	..	..	..	..	
Light coremakers—male	..	11	4	1	4	2	1	8	
Light coremakers—male, helpers	..	..	1	1	..	1	..	..	
Light coremakers—male, trainees	5	17	3	..	..	2	2	..	
Heavy coremakers—male	3	4	2	..	..	2	..	..	
Heavy coremakers—male, helpers	1	3	..	..	..	..	..	..	
Heavy coremakers—male, trainees	1	2	..	..	..	..	..	..	
Coremakers, female	..	..	..	..	..	..	..	..	
Cupola tenders	1	3	3	1	1	2	2	4	
Air furnace tenders	..	..	..	..	..	..	..	..	
Traveling crane operators	3	4	1	..	..	1	..	..	
Chippers	4	23	4	2	10	4	..	1	1
Grinders	2	6	2	1	4	1	2	..	
Sand Blastmen	1	3	1	1	..	..	1	..	
Inside common laborers	20	61	6	..	10	1	1	8	5
Total	77	211	55	19	45	39	23	58	12

* A copy of this questionnaire is shown as Appendix B.

tions listed, during the month of December, 1923, was reported. The number of workers concerning whom detailed information was received amounted to seventy-six per cent. (76%) of all foundry employees at that time. The occupations listed include all those in the foundry with one or two minor exceptions. The tabulated results are shown in Table Number 3.

o. 3

OF DECEMBER, 1923, GROUPED ACCORDING TO PLANTS AND OCCUPATIONS

11	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*	*Total*
10	10	6	10	10	15	13	9	14	3	8	14	2	2	204
..	7	..	6	3	..	8	2	2	..	4	..	..	2	47
..	..	..	1	1	..	1	..	4	..	..	1	..	..	26
6	..	..	2	2	..	16	..	..	..	12	10	3	6	100
4	..	..	..	2	..	16	..	..	..	6	..	..	6	62
..	..	..	..	..	..	2	..	..	..	..	..	..	..	7
..	..	..	..	..	..	..	..	..	..	3	..	..	..	9
..	..	..	..	..	..	..	..	..	..	2	..	..	..	8
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
2	4	15	6	6	9	2	36	8	17	2	6	3	..	154
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
..	2	..	..	..	..	..	..	..	2	..	..	..	..	7
2	2	23	5	..	..	1	..	8	13	4	..	9	..	114
..	..	2	..	..	..	..	..	3	..	4	..	..	..	26
..	2	..	..	..	..	..	..	3	4	..	..	..	..	31
..	6	5	5	3	2	3	4	1	3	3	4	8	..	83
..	1	..	..	..	..	1	..	..	..	1	..	..	..	6
..	2	..	2	..	..	..	..	3	..	..	..	..	..	39
3	..	2	3	1	..	5	..	..	..	3	2	4	1	42
1	..	..	..	..	..	2	..	..	..	1	..	..	1	12
..	..	..	..	..	..	..	..	..	..	1	..	..	..	4
..	..	6	..	..	..	..	..	8	..	..	..	5	..	19
3	..	5	3	1	2	1	2	1	2	1	4	2	2	49
..	4	..	..	..	..	..	..	..	2	3	..	..	12	21
..	1	2	1	1	..	6	..	2	..	2	2	3	4	42
3	5	2	12	2	..	12	2	6	..	6	3	6	2	127
1	6	12	2	2	2	3	2	2	3	..	1	2	..	58
1	1	2	1	1	..	1	1	1	1	2	1	..	..	22
7	1	42	4	..	4	7	22	21	30	1	15	45	10	382
43	54	124	63	35	34	100	80	87	80	69	63	92	48	1703

It will be noted that eighteen foundries are omitted from the above table. Information as to the total number of employees only in these plants is presented in the following tabulation.

TABLE No. 4

NUMBER OF EMPLOYEES IN EIGHTEEN PHILADELPHIA FOUNDRIES IN DECEMBER, 1923

Plant No.	*Total No. of Employees*
25	50
26	65
27	20
28	78
29	15
30	45
31	50
32	66
33	9
34	17
35	14
36	30
37	17
38	20
39	5
40	16
41	6
42	18
TOTAL	541

By combining the totals of Tables number three and number four, we obtain a figure of 2244, the average number of foundry workers employed in all plants during the month of December, 1923.

It will be recalled that the Census of 1920 gave a total of 2064 "iron molders, founders and casters" for Philadelphia. This figure (2064) agrees with an estimate for 1923 by Vice-President Nicholas Smith of the International Molders' Union of North America based on a count of the registered voters who gave their occupation as molders, and upon his knowledge of the industry. Both totals no doubt include some workers who were not molders. It has been noted that the government figure includes "foundry hands" and it is probable that the union figure does also for doubt-

less many foundry workers erroneously gave their occupation as molding when registering as voters.

By segregating in Table Number 3 the figures for molding and coremaking, the following figures are obtained:

TABLE No. 5

COREMAKERS AND MOLDERS EMPLOYED IN TWENTY-SIX PHILADELPHIA FOUNDRIES IN DECEMBER, 1923

Light floor molders	204
Heavy floor molders	100
Loam molders	9
Bench molders	154
Molding machine operators	114
Light coremakers, male	83
Heavy coremakers, male	42
Female coremakers	19
TOTAL	725

Since these molders and coremakers were in plants employing seventy-six per cent. (76%) of the total number of workers, the number of molders and coremakers employed in all plants was 954, if the ratio of coremakers and molders to total workers was the same in all plants. At the time of this study the foundries of the city were operating on an estimated schedule of forty-six per cent. (46%) of capacity expressed in terms of tonnage. On this basis there would be 2074 molders and coremakers in the city when all the foundries were operating at capacity.

When we consider that at the time the Philadelphia plants were employing 954 molders, the thirty-four adjacent plants listed in Appendix C were employing 1060 molders and coremakers, some of whom might possibly have resided in Philadelphia, it appears probable that an estimate of two thousand coremakers and molders for the city is approximately correct.

The statement that the industry was operating at about forty-six per cent. (46%) capacity in December, 1923, is based on the following information as to plant capacities and operating schedules furnished by the foundrymen listed.

TABLE No. 6

CAPACITY AND PRODUCTION IN TONS PER DAY OF TWENTY-ONE PHILADELPHIA FOUNDRIES

Plant No.	*Capacity in Tons per Day*	*Rate of Production In Tons per Day in December, 1923*
1	30	11
2	30	19
3	12	10
4	9	6
5	8	6.5
6	33	10
9	50	5
10	25	15
14	20	12
15	6	2.5
16	5.5	5.5
17	8.5	3.3
18	10	5.5
20	9	4
22	20	15
25	14	8
30	13	1.5
31	9	6
32	7.5	6
34	5	2.5
37	5	4
TOTAL	406	188

The total number of workers employed by each company, with the companies grouped according to types of foundries, is shown below:

TABLE No. 7

WORKERS EMPLOYED IN DECEMBER, 1923, IN PHILADELPHIA FOUNDRIES CLASSIFIED ACCORDING TO TYPES OF SHOP

Light Jobbing Shops		*Heavy Jobbing Shops*		*Light Mchy. Shops*		*Heavy Mchy. Shops*		*Stove Shops*		*Sash Weight Shops*	
Shop No.	*Employees*	*Shop No.*	*Employees*	*Shop No.*	*Employees*	*Shop No.*	*Employees*	*Shop No.*	*Employees*	*Shop No.*	*Employees*
1	77	6	39	3	55	2	211	8	58	27	20
4	19	12	54	13	124	5	45	16	34	36	30
7	23	19	87	14	63	9	121	28	78	..	..
11	43	22	63	10	83	17	100	29	15	..	..
15	35	26	65	18	80	21	69	..	..	..	..
20	80	41	6	30	45	23	92	..	..	..	..
25	50	..	..	33	9	24	48	..	..	..	..
31	50	..	..	35	14	32	66	..	..	..	..
34	17	..	..	37	17	..	..	..	..	..	..
39	5	..	..	38	20	..	..	..	..	..	..
40	16	..	..	..	..	..	..	..	..	..	..
42	18	..	..	..	..	..	..	..	..	..	..
	433		314		510		752		185		50
Aver. No. per Shop	36		52		51		94		46		25

CHAPTER IV

Description of Foundry Occupations

An appreciation of the extent of or the need for training in a given industry must be based upon a knowledge of the work which the employes in the different occupations are called upon to perform. For this reason the most important foundry occupations should be considered in some detail. A glossary of technical terms used is contained in Appendix D.

Molding. Molders from the standpoint of both skill and numbers, usually form the most important group of workers in the foundry. Men who work at iron molding specialize in one type of work and are known to the trade as bench, floor, loam, molding machine, and stove molders. This grouping will be followed in describing the occupation.

Bench molding. Since the bench molder, as previously noted, produces molds which usually weigh less than fifty pounds it is possible for him to lift the flask, sand, pattern, and finished mold to and from a work bench and thus avoid a stooping posture while at work.

The principal duties of the bench molder are as follows. A flask is placed in position on the bench and the drag part of the pattern is put in it. Sand is then shoveled into the flask and rammed firmly about the pattern. The flask is next turned over to permit the pattern to be withdrawn, after which the defects, if any, are remedied by the use of hand tools. Finally, the drag is placed on the floor. These operations are repeated for the cope part of the mold and in addition, there is constructed a gate through which the metal is to be poured and a vent through which steam and gases may escape when the mold is poured. This cycle of work is repeated for each mold. The daily quota of molds is reached sometime during the afternoon and the pouring operation begins. The molder gets the molten iron from the cupola ladle or a more conveniently placed supply ladle, carrying it in a small hand ladle holding usu-

ally about twenty-five pounds. He makes as many trips to the supply ladle as are necessary to procure metal to fill all his molds.

At almost every point in this routine, it is necessary for the molder to form judgments and make decisions which are of considerable importance as regards the output and quality of castings. The question as to which part of the pattern shall be placed in the cope and which in the drag, must be answered, frequently by the molder. The size of the flask to be used must be determined and the decision vitally affects molding costs for if too large a one is selected an unnecessary amount of sand and labor is used; if it is too small, the casting is apt to be defective. He must be able to tell if the sand he is working with is properly tempered. He must know when to ram the sand firmly and when to ram lightly as well as how the various molds should be gated, vented, and weighed. The act of pouring differs with the mold and the iron and decisions as to whether pouring should be fast or slow must be made, sometimes very quickly. While it is true that the responsibility for these decisions is assigned to the foreman or his assistant, close supervision cannot always be given and it is assumed that a skilled journeyman molder can work independently.

In many shops, particularly large scale production shops, the molder is relieved of many of the duties that have been listed. It is unnecessary to shovel sand up into the flask inasmuch as it is delivered by overhead conveyors; cores are set and the mold closed by core-setters; the iron may be poured by a special pouring gang in a casting room to which the mold has been removed by belt or chain conveyors. Under such a plan of operation the molder occupies all his time with the molding operation proper and is, obviously, less broadly skilled than the man who works where the task is not thus sub-divided.

Floor molder. The duties of a floor molder depend to a large extent upon the size of the mold. On side floor work the pattern, although too large to be molded on the bench, is sometimes handled by one molder or a molder and helper. Where the molder handles the entire job, his range of duties is about the same as that of the bench man although he makes fewer and larger patterns and many utilize a hand crane to lift the completed mold. Main floor work

may be so large that it is performed with the aid of a power crane, and a gang of several molders and assistants work together. As in bench work, the molders place the pattern in the flask, ram the sand, supervise the turning over of the flask, withdraw the pattern, repair defective parts, set cores, and pour the metal. Any one molder performs only a part of the work and that portion which is particularly difficult is assigned to the most skilled worker.

Floor work is more difficult than bench work and the molders who perform it are more highly paid as a rule. Part of the increased skill required in floor molding arises from the fact that hanging bodies of sand in large molds are difficult to strengthen and support. The ability to read blue prints is frequently necessary, in order to properly place cores, while proper gating and venting become very important due to the large body of metal used. One writer states, "Molds which are to be made under the crane require considerable skill on the part of the molder and only the more experienced men should be entrusted with this work, inasmuch as the castings made are large and the spoiling of one, due to poor molding, involves considerable loss."[3] Professor Stockton, in commenting on the relative wages of bench and floor molders says "until recent years it was also an accepted feature of the trade that.....bench molders should be paid less than floor molders....The differential between bench and floor molders was based upon the theory that bench work was lighter and less complicated than floor molding."[4] A report of hourly earnings which included "flat rates and additions through bonus or piece work" of floor and bench molders in thirty-two foundries in Philadelphia and vicinity, compiled in September, 1923 by The Metal Manufacturers' Association of Philadelphia showed a difference of 2.4 cents per hour in favor of the floor molders.

Although, strictly speaking, floor molding is carried on in both dry and green sand, the term generally refers to green sand work. A dry sand floor molder is even more highly skilled than a green sand molder. Burton L. Gray says, "The dry sand molder must use the same precautions as the green sand molder in setting

[3] Stockton Palmer, "Foundry Practice," p. 43.
[4] "The International Molders Union of North America," p. 152.

gates and risers and in fastening his sand with cross bars and gagger. At the same time, he works with core sand mixture next his patterns and backs this with a coarse molding sand so that he must combine the skill and judgment of both the green sand molder and the coremaker." [5] Another writer says "dry sand molds are used for intricate castings in which the walls must be of a positive thickness or in which large bodies of metal must remain fluid for a considerable period of time."[6]

Loam molding. A journeyman working in loam is a floor molder, although he is not known in the industry by that term. The more specific and descriptive name of "loam molder" is used. A better appreciation of his duties may be obtained by considering the difference between sand molding and loam molding. It has been noted that in green and dry sand work a pattern and flask are used. Sometimes a foundry is called upon to make a large casting which is of such simple design or which is so infrequently manufactured that it would be too costly to make a complete pattern and use a flask. In such a case loam molding is resorted to. The mold is constructed of soft bricks laid in such a manner as to leave a cavity which roughly conforms to the shape of the finished casting. A mixture of sand, clay, and some form of humus mortar-like in consistency is applied to the surface of the cavity. A "sweep," which is a wood arm revolving about a center and curved to the outline of the casting, accurately shapes the loam surface to final size and form. If the design of the casting is particularly intricate, patterns are often constructed and molded in loam to avoid the use of a large flask.

The loam molder has only blue prints to guide him in setting his bricks and he must be able to read these accurately. Methods of performing the work expeditiously, accurately, and at low cost will vary from job to job and the molder must devise these. It is an occupation which calls for ingenuity and originality. There is apt to be little repetition; every job presents a new set of problems. Gray asserts that "the loam molder requires the greatest all around skill in the whole range of foundry work. He

[5] Gray, "Foundry Work," p. 89.
[6] Palmer, "Foundry Practice," p. 30.

must know all the tricks of the core room and dry sand shop, and most of those in green sand. Added to all this he must have a practical working knowledge of the principles of drawing and must possess to a large degree the foresight of the designer."[7]

Molding machine operating. The term "molding machine operator" designates an occupation which varies according to the type of machine used. In the skill required, the work ranges from that which is almost equivalent to bench molding or floor molding down to that which is high class laboring. Molding machines as already stated, are operated by hand or power and perform one or more of three operations, (1) packing or ramming sand, (2) turning over the flask, (3) drawing the pattern.

The machines which perform only the operation of packing the sand require the molder to fill the flask, turn it over, draw the pattern and finish the mold. For light work the simplest form of such a machine would be the hand squeezer which requires no great amount of skill to operate if the work be plain. For large intricate work, a power jarring machine which has been designed to relieve the molder or his assistants of the laborious task of ramming the pattern by hand. Much skilled work such as strengthening the mold, finishing it, and pouring remains to be done by hand.

Machines which draw patterns are used for the most part on work in which such an operation is particularly difficult and where it is desired to save the molders time in repairing damage due to faulty withdrawal of patterns. All other operations are performed by hand.

Machines which turn the flask, called roll-overs, eliminate only this step. When combinations of these three operations are performed by one machine it becomes apparent that a great deal of the skill of the hand molder is transferred to the machine. The operations usually found in combination are jarring and pattern drawing, rolling over and pattern drawing, and jarring, rolling over, and pattern drawing. Machine operators, like other types of molders, may or may not pour their own iron.

In the development of molding machines, the hand squeezers

[7] Gray, "Foundry Work," p. 97.

and simple hand pattern-drawing machines came first and were used as part of the regular equipment of the foundry for years before power machines came.[8] Stockton informs us that the first important efforts to introduce machines were in the eighties and that "during the last half of the nineties foundrymen began to make more use of machinery." [9] About 1890 a power operated machine designed to ram by a superior method was successfully introduced and was followed by machines to draw patterns by power, and then by a ramming and drawing machine. As Stecker has pointed out, the use of machines was gradually extended from small and purely repetitive work to heavy and intricate castings.

Core-making. This occupation deals with the construction of cores, which are small bodies of sand that have been molded into various shapes for placement in the cavity of a mold in order to form holes or pockets in the casting. Cores, like sand molds, may be green or dry and made by hand or machine. If made by hand, the sand mixed with a suitable binder is put into a core-box, the interior of which is shaped so as to mold the sand into final shape. Dry sand cores are baked in an oven to fix their shape permanently.

There was a time when molders made their own cores but to-day coremaking is a separate trade. The occupation is different from that of molding inasmuch as the sand and binders are quite different. The distinction between heavy and light core-making is largely one of size of the cores and the output of the heavy core-maker is usually used in heavy floor work. Less skill is required in core-making than molding; and the occupation is more cleanly and physical strength does not play such a large part. For these reasons women and girls are frequently employed, particularly on light work.

Molders helpers. This occupation exists to-day in the foundry because there are some tasks which require the services of more than one individual or because it has become necessary and profitable to sub-divide the job and assign the parts which require little skill to workers of lower grade than the journeyman.

[8] Stecker, "The Founders, The Molders, and the Molding Machine."
[9] Stockton, "The International Molders' Union of North America," p. 189.

Very few helpers are employed at bench molding. Table No. 3 (page 14) shows only 1 helper to 154 journeymen. This is because one man can effectively perform all the operations. A light floor molder may or may not have a helper, depending on the size of the casting he is making. If the work is so heavy that one man cannot handle it, a helper is employed. Heavy floor molders usually have helpers more frequently than light floor molders. This is brought out by Table No. 3 (page 14) from which we calculate a ratio of helpers to journeymen in light floor molding of 1:4.3 and in heavy floor molding of 1:1.6.

The duties of a floor molder's helper vary greatly with the policy of the management, the attitude of journeymen, and the nature of the work. In some foundries the helper is but a laborer under another name; he does rough ramming, carries tools, shovels sand and performs other unskilled work. This may be because the nature of the work does not permit him to advance to tasks requiring some skill, or because the journeyman objects, as is often the case with union molders, to the helper using tools which are customarily supposed to mark a journeyman. In contrast to this condition, is the policy of some shops, particularly those that are "open," of permitting and encouraging helpers to use tools as frequently and as soon as possible. In heavy floor molding there is plenty of opportunity to do this, for there are times, such as during the finishing of the mold, when there is not much work which does not involve the use of tools.

The duties of the helper in loam molding are about the same as those in green sand molding. The molding machine operator's helper usually shovels sand, handles flasks, helps move finished molds and does such other semi-skilled operations as will facilitate production. The occupation is distinctly a stepping stone to operating.

Other foundry occupations. The remaining foundry occupations can be considered very briefly inasmuch as they do not affect the training of molders and core-makers. Cupola and air furnace tenders are charged with responsibility for the up-keep and operation of such apparatus. Under their direction the furnaces are charged, ignited, tapped, cleaned, and repaired. Traveling crane

operators, as the term implies, run overhead cranes, which are common to all foundries except those doing very light work. Chippers, grinders, and sand blast men are semi-skilled workers engaged in the task of removing sand and surplus metal from castings by means of the operations suggested by their names. Inside common laborers are employed at the unskilled work of the foundry, such as shaking out castings, shoveling sand, removing cupola debris, etc.

CHAPTER V

The Present Training Program

Having considered the principal foundry occupations and the number of workers employed in them in Philadelphia, the extent and content of the training work which the foundries are engaged in, may next be examined.

The information contained in Table Number 3 (page 14) as to the number of persons in training, supplemented by data obtained from plants not listed therein, is presented in Table Number 8, which follows. The tabulation covers the entire industry with the exception of Plant Number 28, a stove foundry employing 78 workers.

TABLE No. 8

Number of Persons in Training in December, 1923, Classified by Companies and Occupations

Plant No.	*Light Fl. Molding*	*Heavy Fl. Molding*	*Loam Molding*	*Bench Molding*	*Machine Molding*	*Light Core-making*	*Heavy Core-making*	*Total*
1	4	2	..	2	3	5	1	17
2	4	2	..	1	15	17	2	41
3	..	..	..	..	..	3	..	3
4	..	..	..	..	..	..	..	0
5	..	..	..	..	..	..	..	0
6	..	..	..	..	..	2	..	2
7	..	..	..	..	..	2	..	2
8	4	..	..	..	..	..	..	4
9	5	..	1	..	..	1	..	7
10	1	1	..	..	4	2	..	8
11	..	..	..	..	..	..	..	0
12	..	..	..	2	2	2	..	6
13	..	..	..	..	..	..	..	0
14	1	..	..	..	..	2	..	3
15	1	..	..	..	..	..	..	1
16	..	..	..	..	..	..	..	0
17	1	2	..	..	..	..	..	3
18	..	..	..	..	..	..	..	0
19	4	..	..	..	3	3	..	10
20	..	..	..	2	4	..	..	6
21	..	..	..	..	..	..	1	1

TABLE No. 8—*Continued*

NUMBER OF PERSONS IN TRAINING IN DECEMBER, 1923, CLASSIFIED BY COMPANIES AND OCCUPATIONS

Plant No.	*Light Fl. Molding*	*Heavy Fl. Molding*	*Loam Molding*	*Bench Molding*	*Machine Molding*	*Light Core-making*	*Heavy Core-making*	*Total*
22	1	..	..	..	..	..	..	1
23	..	..	..	..	..	..	..	0
24	..	..	..	..	..	..	..	0
25	2	..	..	1	..	1	..	4
26	..	1	..	..	..	..	1	2
27	..	..	..	..	..	..	..	0
28	..	..	..	..	..	..	..	0
29	..	..	..	..	..	..	..	0
30	..	..	..	..	..	..	..	0
31	1	..	..	..	..	1	..	2
32	..	..	..	..	..	..	..	0
33	..	..	..	..	..	..	..	0
34	..	..	..	1	..	1	..	2
35	..	..	..	..	..	..	..	0
36	..	..	..	..	..	..	..	0
37	..	..	..	..	..	..	..	0
38	..	..	..	..	..	..	..	0
39	..	..	..	..	..	..	..	0
40	..	..	..	..	..	..	..	0
41	..	..	..	..	..	..	..	0
42	..	..	..	..	..	..	..	0
	29	8	1	9	31	42	5	125

By comparing the written reports of the companies on the numbers in training with the information secured by personal visit, it became evident that a very liberal interpretation had been given to the phrase "number of persons in training." A few illustrations will confirm this. Plant Number 1, a light jobbing shop, reported 17 persons in training although the foreman stated to the writer that they had only two trainees. Plant Number 10, a light machinery foundry, reported 4 persons in training other than those learning to become machine operators; this is at variance with the statement of the superintendent that no training program had been instituted. Plant Number 14 has evidently listed several handymen or helpers as trainees, inasmuch as the foreman said that no persons were in training.

It is rather startling to note that, regardless of the looseness of the concept of the term "training," twenty-one or fifty per cent. (50%) of the foundries were unable to list any employees under the category. The most important group, numerically, was in the corerooms. Trainees there constituted thirty-seven and a half per cent. (37.5%) of all persons in training, four per cent. (4%) working at heavy core-making and thirty-three and six tenths per cent. (33.6%) at light coremaking. Floor molding trainees ranked next, 37 of them comprising twenty-nine and six tenths per cent. (29.6%) of the total group, twenty-three and two tenths per cent. (23.2%) on light work and six and four tenths per cent. (6.4%) on heavy work. Those learning machine molding ranked third and constituted twenty-four and eight tenths per cent. (24.8%). Bench molding trainees with a percentage of seven and two tenths (7.2) and loam molding trainees with a percentage of eight tenths (0.8%), were comparatively unimportant.

To obtain a proper view of the extent of training in Philadelphia foundries the number of trainees in the several occupations should be compared with the number of journeymen and the ratios obtained. This is done in Table Number 9.

TABLE No. 9

NUMBER OF JOURNEYMEN AND TRAINEES IN TWENTY-SIX PHILADELPHIA FOUNDRIES IN DECEMBER, 1923, CLASSIFIED ACCORDING TO OCCUPATION

Occupation	*No. of Journeymen*	*No. of Trainees*	*Ratios of Trainees to Journeymen*
Light floor molders	204	29	1:7
Heavy floor molders	100	8	1:12.5
Loam molders	9	1	1:9
Bench molders	154	9	1:17
Machine operators	114	31	1:3.7
Light coremakers	102*	42	1:2.4
Heavy coremakers	42	5	1:8.4
TOTAL	725	125	1:5.8

* Includes female coremakers.

If light and heavy floor molding are considered as one occupation, as they are in many respects, the ratio of trainees to journeymen there becomes 1:8.2. It will be observed that floor molding, loam molding, and heavy core-making have a ratio in the neighborhood of 1:9. The remaining three occupations have ratios that vary rather widely from this; bench molding has the lowest, 1:18, and core-making and machine operating are at the other extreme with 1:2.4 and 1:3.7, respectively.

An attempt to analyze the kind of training that is given to the employees listed in the foregoing tables as preparing for journeymanship, should be preceded by a discussion of the prevailing methods of training in foundries.

One immediately thinks of apprenticeship as the most common method of training which the foundry affords the young man who wishes to become a journeyman. While one may question the accuracy of the assumption as applied to present conditions, there is no doubt that apprenticeship has been prevalent since the establishment of the industry in this country. When the molders became organized on a national scale during the sixties admission to the union could be secured only after serving an apprenticeship of four years and this method has continued since then to be one of the avenues of entrance. In addition to the four year rule, another requirement was one which provided "that no boy should begin the trade before the age of sixteen, a rule which has been retained to date." [10]

There is much evidence that at an early date men were reaching the state of journeymanship without serving as apprentices. This was accomplished by working as helpers, or "bucks" as they were first called. Bucks handled patterns, rammed flasks under the supervision of the molder by whom they were hired and paid, and in general performed nearly all the duties of the molder. Prior to the rise of unions in the fifties every molder on piece work had from one to five bucks.[11] Frey & Commons state that the buck began as an unskilled laborer and gradually worked up.[12] By 1877 the buck system had so firmly fastened itself upon the in-

[10] Stockton, p. 176.
[11] Same, p. 179 ff.
[12] Frey & Commons, "Conciliation in the Stove Industry," p. 127.

dustry that the union, despite the fact that it constantly opposed bucks because they were potential competitors of legitimate molders, was forced to provide "for admission of molders who had worked at the trade for four years and were able to prove competency." [13] The practice of the molder employing a large number of bucks who were responsible to him only gradually diminished; by 1900 the system had virtually ceased to exist and it entirely disappeared by the spring of 1904. The helper system, proper, remained in the industry.

There seems to be disagreement among writers as to the distinction between apprentices and helpers. J. M. Motley contends that helpers were in reality apprentices, inasmuch as while working at the trade they acquired sufficient skill to enable them to qualify as journeymen.[14] There is little doubt but that many of them became journeymen. Frey & Commons say that they were often taken in as journeymen after working four years as bucks.[15] Ashworth admits this but contends that they were not apprentices. He draws the following distinction between a helper and an apprentice: "A helper, though he may be a learner of a trade, is primarily employed because he supplies an economic need, and in fixing his wages nothing is deducted for instruction given. On the other hand, an apprentice may assist a journeyman, but the primary purpose for which he is engaged is that he may be taught the trade, though he may incidentally supply an economic need." [16] He would reject the distinction commonly held that apprentices use journeymen's tools and do journeymen's work whereas helpers are employed at unskilled work and are forbidden to use the tools of the skilled worker. He says that throughout industry, helpers as a rule are not restricted to unskilled work but are allowed to upgrade gradually.

The importance of the distinction between the helper and apprentice methods of acquiring trade mastery is sufficiently great, as we shall see later, to warrant our noting the classification which

[13] Stockton, "The International Molders' Union of North America," p. 58.
[14] Motley, "Apprenticeship in American Trade Unions."
[15] Frey & Commons, "Conciliation in the Stove Industry," p. 127.
[16] Ashworth, "The Helper and American Trade Unions," p. 21.

Ashworth makes of the different kinds of helpers in industry.[17] He says there are roughly three types of helpers:

(1) *Remote Helpers.* These are not in intimate contact with the journeyman's work and as a rule are unskilled; they are ordinarily known as laborers. Their work is necessary but may not be claimed by journeymen as part of the trade. In the foundry industry such workers would cut sand or shake out castings. (2) *Helpers proper.* Members of this class have work that is so closely connected to the duties of the journeymen that they are under the direct supervision of the latter. Two kinds of helpers proper are to be distinguished; (a) those who assist mechanics at work some of which cannot be done by one man; (b) those whose employment is due to the advent of division of labor. In the foundry, helpers in a floor molding gang and core setters might be cited respectively as examples of the one type and of the other. (3) *Advanced helpers.* Advanced helpers do all kinds of journeymen's work but under the supervision of journeymen. They are full mechanics in transition. Helpers of this type in the foundry would be experienced floor molders helpers in a shop where the management was definitely fostering upgrading.

As applied to the foundry industry, Ashworth's distinction between helpers and apprentices on the basis of the *purpose of employment* seems to be only partially correct. The distinction exists but it is not the only distinction. Helpers may or may not be allowed to use tools and acquire trade knowledge whereas apprentices always use tools and become journeymen if they stay at the trade and are at all apt.

Another prevailing method of training is the short course. Here the trainee, after obtaining a knowledge of foundry conditions and processes as a laborer, works under instruction for a comparatively short period of time ranging from several weeks to about a year at some specialized branch of the trade, such as machine operating. One Philadelphia foundryman describes the system as follows: "In a good many cases, we take a laborer with more than ordinary intelligence; a man who is able and willing to do a good day's work, and after he has been in our foundry for some time,

[17] Ibid., p. 9.

say three months or more, and has become generally acquainted with general conditions in handling iron, and has been tempering and cutting up sand for molders for some time, we give him a chance to work on the floor alone under instructions, always picking out the plain class of work. This man, we immediately pay five cents per hour more than he has been earning as a laborer. After some time on the floor, if he appears to be an apt man, we might put him on bench work, starting him in using small stationary flasks, perhaps and gradually getting him to use snap flasks.... We have no set rule whereby a man has to work a given length of time at the trade in order to be making a certain amount of money per day; for instance, some men working a year at the trade may be making more than other men who have been working eighteen months in training." This appears to be the common method of training men to operate machines. The estimates given by the foundrymen on the length of time necessary to train machine operators varied from several weeks to one year, depending on the type of work, the machines used, and the men. It was the general consensus of opinion of managers, however, that an apt pupil ought to become a fair producer within six months on work of medium difficulty.

Finally, journeymen emerge from that vague and nondescript group called handymen. Handymen are usually the products of small foundries where the scale of operation forces the management to shift personnel about frequently. Laborers of some mechanical ability are utilized at most of the occupations and thus come to definitely assume the role of utility men. This brings them in contact with various kinds of molding, and where sufficient practice is given, a handyman can eventually qualify as a journeyman molder. A handyman has been described as "a molder, yet not a molder—a man of no skill yet skilled in making simple work—an enigma." [18]

The extent of the conscious and formal assistance which Philadelphia foundry management is giving to those who will eventually become journeymen can best be measured by eliminating

[18] International Molders Journal, January, 1900, p. 22.

helpers and handymen and considering only the number of apprentices and short course trainees.

On the basis of the information which developed in conferences with the foundrymen, there are listed in Table Number 10, all those whom may be classified as apprentices or short course trainees.

TABLE No. 10

NUMBER OF APPRENTICES AND SHORT COURSE TRAINEES IN MOLDING OCCUPATIONS IN PHILADELPHIA FOUNDRIES IN DECEMBER, 1923

Occupation	*Apprentices*	*Short Course Trainees*
Light floor molding	15	4
Heavy floor molding	3	..
Loam molding	1	..
Bench molding	6	..
Machine operating	..	31
	25	35

It will be observed by comparing Table Number 9 (page 30) with Table Number 10, that it has been necessary to reject some of the trainees listed by foundrymen on the questionnaire. The rejections are as follows: 10 light floor molding, 5 heavy floor molding, and 3 bench molding trainees.

Table Number 10, then, measures the definite and formal program of Philadelphia foundrymen to insure an adequate supply of skilled workers in molding occupations.

CHAPTER VI

Adequacy of the Program

How many molders and coremakers should be in training in Philadelphia? The question may be answered in the abstract by saying that a sufficient number should be trained to provide for the replacement of those who leave the industry and for probable future growth. Workmen leave a trade because of death, incapacity due to disease or old age, and employment at other occupations. An exact reply to the query, then, must be based on information as to mortality statistics, occupational disability rates, rate of superannuation, and permanent resignations, as well as past and probable future trends of growth. Numerous attempts have been made to determine, for the country as a whole, the number of journeymen that should be trained. This number has usually been expressed as a ratio of apprentices to journeymen. It is with reference to this ratio that we shall consider the history of the question.

It was not until molders became nationally organized that attention became focused on the advisability of restricting or increasing the number of apprentices. The first national rule of the union applying to the number of apprentices that might be employed in a foundry was passed in 1867 and provided for a ratio of one apprentice to eight journeymen plus one apprentice for the shop. There seems to have been little attempt to base this ratio on a study of the factors listed in the paragraph above. Mr. John Frey, present editor of *The International Molders' Journal* is joint author of the statement that the ratio was "not based on statistics or investigation but on approval." [19] Custom, no doubt, had some influence in fixing the ratio. Prior to 1867 each shop established a ratio and the one which commonly prevailed was one to ten plus one for the shop.

Numerous attempts were made by both foundrymen and molders to change the 1867 ratio. Owners of union shops urged a more liberal rule while the union officials contended for a more re-

[19] Frey & Commons, "Conciliation in the Stove Industry," p. 163.

strictive agreement. Although there is no definite information as to the ratio prevailing in non-union shops it probably was much more liberal than the union shop ratio, if we accept the complaints of the union foundrymen in the matter. In 1891, conferences on matters of mutual concern began between the Stove Manufacturers' National Defense Association, a national body of stove foundrymen, and the International Molders' Union. One of the questions discussed was the apprentice ratio. In 1892 the conferees presented to their respective bodies a joint resolution which said, "as reliable statistics demonstrate the average duration of a journeyman molder's continuance at his trade to be less than sixteen years, it is necessary, in order to maintain a proper supply of competent workmen, that one apprentice be employed for every six journeymen or one for every seven floors operated." [20] The statistics referred to were not published in the trade papers nor in the union journal. Union molders rejected the proposed change and it was not until 1899 that formal action was again taken in the form of a conference recommendation that statistics be secured in order to determine the ratio. In the 1901 conference, the foundry produced statistics showing that the one to eight ratio had never been in general practice and furthermore could not maintain a supply of journeymen. The union, upon investigation, also decided that the theoretical ratio of one to eight was not being observed and that it was about one to five. No change was made, although the matter was thoroughly discussed. In September, 1904, it was stated editorially in the *Journal* that, "from data which covers the leading stove foundries we find that the average number of years that a stove molder works at the trade to be less than twenty." Finally, after 38 years the ratio of one to eight and one for the shop was changed in 1905 to one to five and one for the shop. In 1907, it was extended to cover all foundries instead of stove shops abone. Since 1907 no change has been made.

The present ratio, then, of one to five and one for the shop appears to have been based in part on a study of the ratio that had actually prevailed from about 1901 to about 1904 and upon

[20] Stockton, "International Molders' Union of North America," p. 172.

a study of the number of years journeymen worked at the trade. It is not known definitely what these statistics were but from the discussions which appeared in the *Iron Molders' Journal* during 1904, the union's attempt at corroboration seems to have consisted in taking the average length of service of molders employed in representative shops. The actual ratio in force at the time the negotiations were under way became, under these circumstances, the basis for the theoretical one. It may be that the foundrymen pursued the same method; certainly no evidence of more careful action is available. Such data should be rejected for a ratio can be calculated only on trade mortality, that is, the death rate to the trade, of the journeymen in it.

Since the present ratio was agreed upon in 1905 and 1907, no effort has apparently been made by either the manufacturers' organization or the union to collect information on the rate of exit of workers from the trade, upon which a sound policy of training might be built. The Financier of the International Molders' Union of North America writes in response to an inquiry on the matter, "I regret to say that I am not able to give you any definite information concerning the average length of working life of the molder, for we have never had any occasion in the past to keep a record of this kind." The Stove Founders National Defense Association similarly reported that it had "no statistics on the subject."

The calculation of a ratio for a particular city is even more difficult than for the entire country. In addition to any local factors which may affect the rates of mortality and the flow of workers to other occupations, it is necessary to measure the shift of workers to and from the community, for a journeyman who departs permanently to other centers is as surely lost to the local industry as though he were deceased and, conversely, an arrival in the ranks is the equivalent of a graduated apprentice. There is within easy access of Philadelphia a group of 54 foundries which, on the basis of the information listed in Appendix C can be said to employ nearly twice as many workers as Philadelphia foundries. To and from these shops, Philadelphia workers may migrate with ease, and the extent of that migration must be known in order to determine trade mortality. In this connec-

tion it should be noted that the foundry industry, like the printing trades, contains many itinerant journeymen.

A comparison of the existing Philadelphia ratios with the one that actually prevailed in the industry for a number of years (one to five), while it will not reveal the extent of the present deficiency, will show the present training program to be clearly out of line with past experience.

First the most favorable possible view of the present program may be taken and it may be assumed that all those listed in Table No. 8 (page 28) are being trained by the companies. In floor molding the ratio would be 1:8.2, much below the old standard of 1:5. In loam molding the ratio would be 1:9 and in bench molding 1:17, both below the former standard of 1:5.

But, as already pointed out, only a few of those listed can be said to be receiving legitimate training, even when allowance is made for short course trainees. Therefore, when ratios are calculated on the basis of Table No. 10 (page 35) which eliminates all those who could not fairly be said to be in training the discrepancy becomes even greater. The ratio in floor molding then becomes 1:13.8 as compared with 1:5. To put it differently, instead of a quota of 61 floor molding apprentices there are now 22, four of whom are definitely in the short course group. In bench molding, a count of bona fide trainees only gives a present ratio of 1:25.7; instead of 31 apprentices there are 6. It appears to be very probable then that the number in training in bench, floor and loam molding is much out of line with the number that would be called for under a ratio based on proper information.

The present number of trainees in bench and floor molding, then, indicates a coming shortage of journeymen in these branches. The gravity of the situation, however, is by no means revealed by a study of the number now being trained. The cumulative effect of past neglect will soon exert itself. This is indicated by the results of a survey which will now be described.

Interviews were held with 101 skilled floor and bench molders employed in 7 foundries, 3 of which were union shops and 4 of which were open shops. These men, all of whom had served

apprenticeships furnished information from which it was possible to construct Table No. 10A.

TABLE No. 10A

NUMBER OF BENCH AND FLOOR MOLDERS IN A GROUP OF 101 JOURNEYMEN ENTERING INTO APPRENTICESHIP IN THE DECADES INDICATED WITH AVERAGE LENGTH OF SERVICE AND AVERAGE AGE OF EACH GROUP

Years	*Number Entering Apprenticeship*	*Per Cent of Total Group*	*Average Present Length of Service in Years*	*Average Present Age*
1870-79	6	5.9	48	62.3
1880-89	23	22.8	37.9	54.3
1890-99	26	25.7	29	45.2
1900-09	36	35.6	19.3	36.6
1910-19	10	9.9	9.3	26.4
TOTAL GROUP.	101	..	26.7	43.3

If the distribution of these 101 molders as to age and length of service is typical of the entire group, several significant conclusions stand forth:

(1) The average length of service in Philadelphia, 26.7 years, is considerably in excess of the average for the trade as a whole of "less than twenty years" reported during the first years of the present century.*

(2) Philadelphia foundrymen may expect to lose in the near future a considerable number of those who entered the trade during the seventies and the eighties. There can be little doubt that the losses will be exceptionally heavy in the first group where the length of service of each man averages almost half a century. In the second group the average present length of service is 37.8 years as contrasted with the estimate of about 20 years for the trade. Retirement and death will soon make heavy inroads here. If one considers that these two groups comprise 28.7% of all bench and floor molders in the city, the necessity for providing replacements becomes obviously apparent.

* This figure, 26.7, is not the average length of life in the trade of molders, for it does not take into account exits due to death, resignations, etc.

(3) Since 1910 very few men have come into the industry through apprenticeship. In the ten years, 1910-19 the workers who came in constituted only 9.9% of the total and at present there are only 24 individuals in all Philadelphia foundries who can, by liberal interpretation, be termed apprentices.

The conclusion is, then, that there are proportionately too few men who are in their twenties and an exceptionally large number who are in their fifties and sixties. The exits from the older groups will soon force the foundrymen to give to the question of training the attention that it should now be receiving.

In the occupation of machine molding where a ratio of 1:3.7 exists, the supply appears to be more adequate although the possibility of rapid expansion in this branch must be considered. Perhaps the fact that the ratio is high is evidence that preparatons are under way for expansion. The status of machine molding in the city may be examined from this point of view. Table No. 11 presents in condensed form much of the information that was collected on machine molding.

TABLE No. 11

NUMBER OF MOLDING MACHINES, NATIVITY OF OPERATORS, AND OTHER INFORMATION ON MACHINE PRODUCTION AS OF DECEMBER, 1923, IN CERTAIN PHILADELPHIA FOUNDRIES

Plant No.	*Per Cent of Production on Machines*	*Nativity of Machine Operator*	*No. and Kinds of Machines*	*Comments of Foundrymen*
1	10	American	1 R & D	Installed since war; would put in two roll-overs if space were available.
2	75	Almost all Poles or Lithuanians	20 S, RO	Doing twice as much machine work as five years ago. Lack of space prevents use of more machines.
3	65	All Poles	7 S	No addition to machinery for 14 years.
4	16	Poles	2 RO	Installed during the war.
5	..	..	..	Could use machines for some work, though not much.
6	..	..	..	Will install machinery for 60-75% of work.
9	..	..	..	Undecided; could handle about 2% that way.
10	40	Foreign & Colored	8 SP, 2 RO, 1 J, 1 MP, 26 Spec.	Put in 2 roll-overs two months ago, and the match plate six months ago. Change to machine work coming fast.

TABLE No. 11—*Continued*

NUMBER OF MOLDING MACHINES, NATIVITY OF OPERATORS, AND OTHER INFORMATION ON MACHINE PRODUCTION AS OF DECEMBER, 1923, IN CERTAIN PHILADELPHIA FOUNDRIES

Plant No.	*Per Cent of Production on Machines*	*Nativity of Machine Operator*	*No. and Kinds of Machines*	*Comments of Foundrymen*
14	33	All Foreign	8 S, 4 RO, 3 SP	No more work can be put on machines.
15	..	..	..	
16	..	..	..	
17	..	..	..	Probably 20% could be put on machines. Have hesitated, due to ups and downs in foundry production.
18	..	..	..	
21	..	50% Italians	2 J, 3 J&R, 8 S	Machine work constantly increasing; went up 65% last year; will continue.
20	60	Poles	17 S, 1 RO	Equipment installed 15 years ago. No recent increase in machine work.
22	..	..	..	
24	..	..	..	
25	..	American	4 S	Installed since war. Would put in 2 roll-overs if space were available.
26	..	..	..	
29	..	..	..	Miscellaneous work not adapted to machines.
30	50	All Poles	9 S, 1 RO	Machines have been in about 12 or 14 years.
31	..	..	..	Hope to put in a squeezer.
32	24	Austrians	2 SP, 4 S	Have had machine equipment for 20 years. Could not put in more because of lack of space.
34	..	..	..	
37	..	..	..	Very little work for a machine.
42	..	Austrian	1 S	Installed three years ago. Cannot put any more of present work on a machine.

R & D—Roll-over and draw machine.
S—Squeezer machine.
RO—Roll-over machine.
SP—Stripping plate machine.
J—Jarring machine.
J & R—Jar and roll-over machine.
MP—Match plate machine.
Spec—Machine for special work, such as gear molding.

One may safely surmise from the foregoing information that machine production will increase. Ten of the twenty-six plants listed state that there is a possibility of expansion, and it is only lack of space that delays four of them. Four of the plants appear to be in a stationary position for there has been no increase in equipment for about 15 years. Five definitely state the improbability of installing or adopting more machines. Stecker has pointed out that prior to 1913 there was a distinct trend toward the increased use of machines in the foundries attached

to the National Founders Association. This data is attached as Appendix E. There appears to be no reason to believe that since that time the trend has changed. The number of complaints about the lack of apprentices voiced in all the publications of the trade has increased. Special training courses for helpers, handymen and laborers appear to be more numerous. Improvements in machine equipment calculated to make machine production more flexible have been effected. These would seem to be indications of increased future use of molding machinery.

The ratio of apprentices to journeymen in coremaking, like that in machine operation, is more than adequate according to old standards. There appears to be no explanation for the large number of trainees in light core-making unless it is that the occupation is cleaner and less laborious than molding. In heavy core-making there is a deficiency of trainees but this is not serious inasmuch as a marked shortage would no doubt attract members of the light-coremaking group.

Quite apart from the question of the number that should be in training is the problem of the kind or method of training. When the solution to it was sought from the foundrymen much diversity of opinion was encountered except as regards the field of machine operating. They were agreed that the prevailing method of advancing laborers to machines to work under instruction for some months at day rates slightly above those of laborers, before allowing them to operate the machine independently on piece rates, is satisfactory. This view appears to be correct for all but a few classes of machine work. The usual run of machine operators are not high grade molders. Improved, power-operated machines have eliminated much of the skill of the worker in ramming, turning over, rapping and withdrawing the mold. Even judgment by the operator in such matters as the temper of the sand is not often necessary. A writer in *Foundry* quotes the Engineering Editor of *The Foundry* as saying in this regard: "While molding skill, manual dexterity, and mature judgment on the part of the workman are regarded as an important requirement in a jobbing shop, they are neither an asset nor a necessity in a specialty foundry. Power driven devices, accurate patterns and flask equipment and mechanical appliances for handling materials and making molds have re-

duced the personal element to a minimum.... In many cases, as has been demonstrated, the superior precision of the machine actually has resulted in both a more uniform and a better product than possibly could be produced by the most skilled molders and so-called old time foundrymen."

Indeed, there is doubt whether it would be possible to induce the type of worker who takes up machine molding to undergo training more extensive than is now given. The type of worker who takes up machine operating would not desire to remain at trainee rates for a period as long as that of apprenticeship. The trainee rates are low and must necessarily be so in view of the training which the foundrymen give. The trainee, on the other hand is usually an ambitious laborer with an urgent desire to increase his pay as soon as possible. Also, he is usually more mature than the apprentice and less willing to endure an extended period of training. It should be noted here that Table No. 11 (page 41) shows that foreign born workers, particularly Poles, predominate among machine operators. Native workers avoid the occupation. This is largely because the molding machine, although it is a labor saving machine in the sense that it reduces labor costs, increases the task of the individual molder. He has more sand, flasks, patterns and iron to handle and is therefore usually a man of some physical endurance. It can be said that prevailing methods in the main satisfactorily solve the machine operator problem.

Unanimity of opinion on training matters disappears when foundrymen discuss bench and floor molding. Estimates of the proper length of the training period vary from those of the foundrymen who stated they "could train a good molder in six months" to the common view that the requisite skill could only be acquired by serving a four year apprenticeship. Some contend that the trade school offers the solution, while others argue for a central training shop. Some would do away with apprenticeship altogether and substitute the helper system.

There is little doubt that the apprenticeship system, properly administered, will usually turn out a competent floor or bench molder in four years. But proper administration means that the minor must receive instruction. When a boy enters his trade the management, in view of the low rate of wage that prevails,

definitely assumes the obligation of providing such instruction. It has usually met the obligation by putting the boy into the shop with instructions to the foreman to have him "spend some time at the various jobs." The apprentice who takes up bench molding and remains six months in the core-making and six months in the cupola departments under the supervision of workmen skilled in the processes, and is afterwards sent for a similar period to the bench as assistant to an experienced journeyman, and is finally placed between two experienced molders who are instructed to teach the boy by example and information, all phases of that branch, should at the end of four years be a skilled mechanic. Similarly in floor molding, instruction in the coreroom and at the cupola are deemed to be necessary. If the work is light molding, a six months period as assistant to a molder and later a floor between two experienced journeymen are features of a well-organized course. It is assumed that in all these branches the apprentice will get a variety of work and will have the benefit of supervision by the foreman or some other representative of the management. Teaching content is undoubtedly the most important part of the job during apprenticeship.

But some foundrymen contend that the training, while all right in itself, requires too much time or that there are other more effective ways of getting journeymen than by putting minors through a four year period of training. The possibility of shortening the time of apprenticeship, or of acquiring skill without going through it, are moot questions. Twenty-five foundrymen registered definite opinions on the subject. Fifteen contended that four years of apprenticeship training were necessary for general bench and floor work, while ten believed such a long period was not required. It is significant that nine of the ten men who desired to reduce the time of training would employ men older than the usual apprentice. One of the men interviewed stated that "a man of twenty-five can be developed into a molder in six months;" another asserted that "an older man can become a fair producer in six months. Molding is not as difficult as some would suppose." Other statements in the same vein were "I can make a better molder out of a laborer or a handyman than an apprentice and in less time," and "some of the best molders in Philadelphia were

formerly handymen or laborers. They are the best material." One manufacturer said that helpers could be developed into skilled molders in two years. He thought it would be necessary to continue to pay the helper rate of pay and that the process "might be slightly more expensive than straight apprenticeship." The lack of desire on the part of these foundrymen to take on minors was based, not on the belief that the minor could not learn the trade as readily as an old employee, but on the belief, (based on experience) that the younger man did not possess such a strong desire to become a molder.

Training by means of short courses for laborers, handymen and helpers is not peculiar to Philadelphia. The Secretary of the Milwaukee branch of the National Metal Trades Association describes such work in his district as follows: "The handymen are usually helpers desiring to learn more of the trade—are over 21 years of age and usually limit their learning to some special line—two years is the length of their contract—wages are usually fixed according to the case." The following statement comes from the Southern Connecticut district: "We....are still sticking to the old fashioned method of taking a likely looking foundry worker and giving him some special attention with the idea of making a molder of him. This special attention is generally given by the foreman, or sub-foreman or in some cases by molders who have become too old to fill their trade." A correspondent, in speaking for the industry in Columbus says, "Generally speaking there are very few foundries doing outstanding work.... Most of them employ skilled men when available, and during a scarcity of molders, employ unskilled men and 'break them in' on the job. The period of training in this work depends altogether on the aptitude of the man." The chairman of an apprenticeship committee in an association of foundrymen in the Moline-Davenport-Rock Island district reports, "In checking up the situation in this community, the committee found that generally most of the foundries were taking on inexperienced help, and developing what has come to be known as specialty molders. It was found that this was being done in a more or less haphazard way, and only when experienced molders were not available."

It appears to be possible to become a journeyman floor or

bench molder without serving a four year apprenticeship. In floor molding, this can be accomplished without any formal training. If a variety of work is being handled and the helper gets an opportunity to use tools, if the journeymen with whom he is working display a co-operative spirit, if he has native mechanical ability, the very nature of his duties make it possible for him to acquire trade mastery. He is in intimate contact, if it is large work, with those who perform skilled tasks. He learns through example and practice just as the appentice does, although perhaps not so rapidly. Stockton says that "at present in car wheel shops and other establishments where large castings are made the helper proper has partially replaced the apprentice, altho as a rule he does not finish molds. He does, however, prepare the chill, insert the pattern, ram the flask and assist in pouring off.... Generally speaking it can be said that in shops where small castings are made, the work of the helper is so remote from that of the molder that helpers have little opportunity to learn the more skilled processes of molding. In such cases the apprentice system prevails."[21] To the apprentice system, Stockton should have added also the short course method which has been described as existing in Philadelphia as well as in other important centers throughout the country.

The question of the desirability of training molders in trade schools was raised with the foundrymen. There was unanimous opinion that any knowledge of process and materials acquired in a trade school would have to be supplemented by training within the plant itself and that the most desirable place to acquire a trade was in the plant itself, under the conditions of commercial production. The only school in the Philadelphia district where a trade education in molding can be obtained is Girard College. The course there is two years in length; foundry instruction is given in the morning and English and mathematics are studied in the afternoon. The instruction in molding embraces cupola practice, core making, bench molding and floor molding. Cores and molds are made and iron is poured under the supervision of the instructors who give shop talks and demonstrations on sand and core

[21] Stockton, "The International Molders' Union of North America," p. 185.

work, the proper use of tools, calculation of casting weights and mold pressures, and the making of castings. The study of pamphlets on the various phases of the trade forms part of the course. At the end of 1½ years, boys are frequently placed in foundries for the remaining six months. This is an arrangement whereby the pupils are alternated between the shop and school at intervals of two weeks. Several employers spoke with satisfaction of the training which the boys from the school possessed when they came to the foundry. But the school with its present equipment cannot become an important element in the training situation. Facilities are available for graduating only about four or five boys per year. But the equipment, limited as it is, is utilized only to the extent of 20% of capacity due to the fact that the students do not elect the foundry course. For the past five years only about one student per year has been graduated. Throughout the country, trade schools do not appear to be playing an important part in the training of journeymen. Numerous inquiries revealed only two, other than Girard College, that were active. One of these, located in New England, definitely announces that it aims to train men for executive and technical positions rather than for journeymanship. The other one has had a checkered career. At one time it was forced to close down because of financial difficulties. A foundryman, who has been quite active in its support in the past, now writes: "I am gradually coming to the conclusion that all classes of apprentices, foundry apprentices included, are best trained in manufacturing establishments under every day business conditions." In considering the part that trade schools may play in the future in training journeymen molders, it is well to have in mind the significance of the fact that the most successful trade schools of any kind have been privately endowed. Douglas[22] cites a statement of the supervisor of industrial education in Milwaukee that the cost per student in the public trade school of that city is approximately $250.00 per year. In endowed schools the cost has been known to be four times as great.

In addition to shop and trade school training, supplementary courses in subjects allied to molding should be examined when

[22] Douglas, "American Apprenticeship and Industrial Education," p. 194.

considering foundry training. Such courses usually cover shop arithmetic and blue print reading although the correspondence schools also offer instruction in molding, coremaking and cupola practice. Foundrymen reported that very few employees were enrolled in these courses and there was diversity of opinion among the 27 employers consulted as to the need of journeymen for a knowledge of shop arithmetic and blue print reading. In the light shops eight negative and five affirmative replies to the question were received. In the fourteen heavy shops, only two employers stated that a journeyman did not need to have a knowledge of arithmetic and blue print reading. All the foundrymen, regardless of their attitude as to the necessity for taking such courses, were of the opinion that it would be extremely difficult to induce workers to take them. One superintendent remarked that he had known of only one molder in twenty years taking such a course. There is no doubt that in heavy floor molding, the workers would be much more efficient if they could read a blue print and thus be able to set cores without instruction from the foreman, and that in all shops such knowledge would enable them to qualify more readily for foremanship. The short sightedness of many of the foundrymen in the matter is aptly illustrated by the attitude of one of them who in succeeding sentences deplored the shortage of good foremen and said that a knowledge of shop arithmetic and blue print reading was not needed by molders. Instruction in molding practice, coremaking and cupola practice, such as is offered by the International Correspondence Schools, was very favorably regarded by many foundrymen, some of whom had taken such courses. The extent to which correspondence courses are utilized throughout the country is not known; but it must be fairly great for one of the largest schools of the kind reports an annual enrollment in its foundry courses of about 400 for the past six years. One company which has been notably successful in training foundry apprentices writes: "We are at present relying upon the correspondence school courses to present the necessary fundamental related trade technique for all apprentices. There are parts of these courses, however, which need some elaboration, the amount depending upon the intelligence and ambition of the individual boy. This elaboration we carry on in our own class room, and attempt to make it fit individual needs."

CHAPTER VII

Proposals and Summary

The foregoing analysis of the extent and nature of training in Philadelphia foundries has revealed a marked decline in apprenticeship. Whereas under standards existing twenty years ago in the trade, the number of bench molder's apprentices should be 31, it is 6. Instead of 61 floor molding apprentices, there are only 18. How is the need that is revealed by this comparison to be met? An answer to this question must be sought for each of the occupations, inasmuch as their needs vary greatly.

In bench molding it has been noted that the helper system is practically non-existent and must be so by the very nature of the occupation. It becomes unnecessary, therefore, to consider helpers as a source for recruiting journeymen. The short course method of training as has been shown has been developed and is being utilized both in Philadelphia and other centers to train the so-called specialty molder. Because of the intensity of the course, a knowledge of shop practice covering a wide range of work cannot be obtained, and it is accordingly not well adapted to fit men for bench work in a light jobbing shop. There are not many specialty bench molders in Philadelphia. It has been shown that 28.6% of all shops do light jobbing work and if the bench work in the light machinery shops is added, it becomes apparent that bench molders on repetition work form an unimportant class. The few bench molders needed for specialty work should be trained by short courses. Such trainees should not, as a rule, be minors. The conclusion, then, is that bench molders in Philadelphia should be trained largely by the apprenticeship method.

The analysis of the occupation of floor molding has shown that the duties of the helper, particularly in heavy floor molding, are such that he may gradually acquire trade skill if permitted to do the various kinds of work involved. The helper system then may become the source of supply of some journeymen and it would seem to be advisable to recommend that it be regarded as such. It will be necessary under these conditions for the foundrymen

to change their point of view toward the helper who, in the past, has been regarded as a laborer. Not until one of the recurring periods of shortage of journeymen arrives is the helper regarded as a potential mechanic. The foundryman then endeavors quickly to impart the knowledge that he should have been systematically and constantly teaching. It should not be necessary in any foundry for a worker to "pick up" a trade, for the process is too wasteful. A helper who shows a desire to learn should be encouraged just as much as is the apprentice, provided of course that labor costs are not increased. However, foundrymen should look to the apprentice system in the main for all around floor molders. The requirements of skill are high, especially where the work is miscellaneous as in the jobbing shops which are so predominant in Philadelphia, and it is advisable to begin to learn the trade at as early an age as possible. Short courses do not appear to be well adapted to floor molding and unless the work is light and restricted in range they should not be installed.

It has been shown that training does not constitute one of the problems of machine molding and coremaking and it is not necessary, therefore, to change present methods in these branches.

The difficulty of recruiting apprentices is the most serious phase of the entire problem. This is in part the fault of the foundrymen themselves. Most of them are fatalistic in their attitude and blame the shortage of candidates on the nature of the industry. Invariably, their assertion was, "We can't get boys to take up the trade. It is too hard and dirty. Present day boys want white collar jobs." Some of the plants have not had apprentices for ten years and all of them are so resigned to the present situation that they are making little real effort to obtain them.

The difficulty of getting boys to take up the trade can be overcome in part only by co-operative effort on the part of the foundrymen. Information about the true nature of the industry should be disseminated. Molding is looked upon by the uninitiated as a particularly hazardous occupation due, no doubt, to the part that molten metal has in the process. The facts do not bear out this view. Mr. Louis I. Dublin, Statistician for the Metropolitan Life Insurance Company writes: "It seems to me that with the exception of the more highly paid occupations and the more haz-

ardous jobs, as sand blasting, tumbling barrel operators, and a few others, the bulk of the men in foundry employment are of the same type as our industrial policyholders. I think you would not be very far out in accepting these rates (death rates for white male policyholders insured by the Industrial Department of Metropolitan Life Insurance Company attached as Appendix F) as representative of the foundrymen's mortality." These rates are about the same as the rate of "slightly over ten per thousand" which exists for members of the International Molders' Union of North America. A further check is provided by a table of mortality rates covering a large group of foundry workers which shows a rate of 10.7 per thousand for workers of all ages, (Appendix G).

Prospective apprentices and their parents and all others who are in position to influence boys who normally would go into industrial occupations should know that molding provides an opportunity for the exercise of manual dexterity, since the tools are hand ones and their use calls for delicacy of touch and skill in manipulation. They should know that the work presents problems which differ with each pattern and eliminate monotony, and that, while it is true that the molding operations are dirty, the grime of the worker is, as one foreman put it, "clean dirt." That is to say, it is easily removed in contrast to dirt in a machine shop which because it is greasy is difficult to remove.

Another feature of a co-operative program is the establishment in all shops of uniform rates of pay for apprentices. Wide variation in present and past rates was found and this is a possible source of dissatisfaction. A standard form of indenture should be adopted, as there is some evidence in other foundry centers that a written, formal contract adds dignity to the apprenticeship agreement and may possibly retain boys who might, without it, drift from the trade.

The essential elements of shop practice for each type of molding should be agreed upon and taught to the apprentices in a standard form. Under present conditions, an apprentice may or may not acquire the rudiments of all phases of foundry work, depending on the shop in which he receives his training. Every effort should be made to have apprentices, particularly those in heavy

floor molding enroll in evening or correspondence schools for instruction in the blue print reading and shop arithmetic.

It has been suggested by some of the foundrymen that the supervision of those features of a program which are essentially co-operative should be assigned to a paid executive. There seems to be merit in such an arrangement. Employers who are attempting to provide training regret the lack of central administrative authority as regards training matters in the industry.

But apprenticeship is to be revived largely by the individual efforts of the foundrymen. Each one must accept responsibility for adequately training his quota of journeymen. One half of the shops cannot assume the entire burden, as at present. Physical working conditions must be improved in many of the shops. While the foundry process makes it difficult to keep the shop clean, there is little excuse for the inadequate heating, lighting and ventilating equipment found in many establishments. The excuse that the work is hard can be partially removed by the installation of mechanical devices so that some of the lifting, carrying of iron, heavy ramming, etc., can be eliminated. There must be a more sympathetic attitude toward the apprentice than the one expressed in the term "sand rat," which has meant in the past that his chief duty was shoveling sand. Journeymen and foremen must assist in the training if boys of proper caliber are to be induced to remain in the foundry.

Many employers contend that their trade is of such a nature as to bring in only "tough and low grade boys." No doubt the boys who refused to enter or remain in the industry were but reflecting the owners' attitude of disparagement toward the occupation.

Summary

The following statements summarize the findings and conclusions of that portion of the study which deals with the size and content of the training program in Philadelphia foundries:

(1) The problems of training are confined largely to the bench and floor molding departments inasmuch as there is no dearth of molding machine operators or coremakers.

(2) In bench molding the number of trainees is especially inadequate. Here it is clearly impossible to recruit by means of the helper system. The inadequacy can be met only in part by training under the short course system, inasmuch as it is adapted chiefly to specialty molding, which is not important in Philadelphia. Main reliance must be placed on straight apprenticeship to secure the all around bench molder who is so necessary because of the jobbing nature of the business.

(3) In floor molding the shortage of trainees can be met by using the short course system if the work is repetitive, light and fairly restricted in scope. Otherwise, the helper or apprentice systems must prevail. There is more likelihood in heavy floor molding than in light floor molding that the helper system will be an important method of training. The helper method must be altered to provide for more training content. Apprenticeship will continue to be important because floor molding in Philadelphia foundries is not largely repetitive, and because it is not likely that helpers will fully supply the need for skilled floor molders.

(4) Trade schools will not supply Philadelphia foundries with many journeymen.

(5) The difficulty of recruiting apprentices is in the main the fault of the foundrymen, who have not given their industry the proper publicity so as to attract boys to the trade, and have not co-operated to work out a program effective in retaining the apprentice after he comes into the foundry.

(6) The elements of a joint plan of action are the establishment of a uniform plan of shop training for each branch of the molding trade, and perhaps the employment of a training supervisor.

(7) Individual foundrymen must accept their share of the training program. Physical working conditions must be improved. Foundry management should attempt to make the molding occupations less laborious and should by example stimulate among their workers and foremen an attitude of encouragement toward those in apprenticeship.

APPENDIX A

OCCUPATION DESIGNATIONS, INCLUDED IN THE TERM "IRON MOLDERS, FOUNDERS, AND CASTERS" IN THE FOURTEENTH CENSUS (1920)

Iron molders, founders and casters:

Bench molder (any iron or steel working factory).
Caster (any iron article).
Caster (an iron or steel working factory).
Caster, car or railroad shop.
Caster, iron foundry.
Caster, metal (n.s.).
Caster, shipyard.
Caster, street or steam railroad.
Caster, wagon or carriage factory.
Floor molder (any iron or steel working factory).
Founder (any iron or steel working factory).
Founder, iron foundry.
Foundry hand, iron foundry.
Foundryman, blast furnace.
Foundryman (iron or steel).
Foundryman, foundry (or n.s.).
Iron founder.
Iron molder (any).
Mold maker, steel mill.
Molder (any iron article).
Molder (any iron or steel working factory).
Molder, boiler factory or shop.
Molder, car or railroad shop.
Molder, car-wheel factory.
Molder, fan factory.
Molder, foundry (iron).
Molder, foundry (n.s.).
Molder, iron foundry.
Molder, iron molder.
Molder, iron or steel.
Molder, machine or machinery (n.s.).
Molder, machine shop.
Molder, metal (n.s.).
Molder, pipe works.
Molder, radiator factory, works, or company.
Molder, shipyard or navy yard.
Molder, (steam) pump factory or works.
Molder, stove factory, foundry, or works.
Molder, street or steam railroad.
Molder, tin-plate mill.
Molder, wagon or carriage factory.
Steel molder (any).

APPENDIX B

QUESTIONNAIRE EMPLOYED IN TAKING CENSUS OF WORKERS

Please fill in and return promptly to

THE METAL MANUFACTURERS' ASSOCIATION
OF PHILADELPHIA
308 Chestnut Street, Phila., Pa.

CENSUS OF IRON AND STEEL FOUNDRY WORKERS (EXCLUDING BRASS)
OF THE PHILADELPHIA DISTRICT

(For the Purpose of Securing Information on
Training of Molders and Coremakers)

(*Note: Do not include among those in training, persons who are hired to perform helpers' work only, such as shoveling sand, rough ramming, etc.)	*December, 1923*			*March, 1923*		
	No. of Skilled Workers	*No. of Persons in Training* *Note*	*No. of Helpers*	*No. of Skilled Workers*	*No. of Persons in Training*	*No. of Helpers*
FLOOR MOLDERS						
Light green and dry sand work, where weight of castings is under 1500 pounds						
Heavy green and dry sand work, where weight of castings is over 1500 pounds						
LOAM WORK						
BENCH MOLDERS						
MOLDING MACHINE OPTRS.						
COREMAKERS						
Male — Light or Oil Sand						
Male — Heavy or Gravel Sand						
Female						

NUMBER OF OTHER EMPLOYEES

Cupola Tenders ..... Chippers .....
Open Hearth Air Furnace..... Grinders .....
Travel. Crane Optrs. ..... Sand Blastmen .....
Inside Common Labrs.....

Firm .....
Signed by .....
Date .....

APPEN

NUMBER OF WORKERS, CLASSIFIED ACCORDING TO OCCUPATION, IN TE

Occupation *Firm No.*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*
Light Floor Molders..	11	40	3	46	3	2	8	42	3	13	15	17	4	7	20
Light Floor Helpers..	11	..	..	2	..	..	4	26	3	2	..	15	..	..	7
Light Floor Trainees.	6	5	1	1	..	..	..	4	..	..	2	..	1	..	..
Heavy Floor Molders.	15	..	7	..	2	..	..	6	..	..	..	..	..	..	..
Heavy Floor Helpers.	11	..	..	..	1	..	..	5	..	..	..	..	..	..	..
Heavy Floor Trainees	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Loam Molders	..	..	..	..	..	..	..	6	..	..	..	..	..	..	..
Loam Helpers.....	..	..	..	..	..	..	..	6	..	..	..	..	..	..	..
Loam Trainees	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Bench Molders	..	14	2	2	4	5	7	2	..	7	2	2	25	1	20
Bench Helpers	..	3	..	..	..	..	3	..	..	..	..	..	..	..	..
Bench Trainees	..	1	..	..	..	..	..	..	..	2	..	..	7	..	..
Molding Machine Operators	8	3	..	1	5	..	7	7	19	1	..	3	2	10	..
Molding Machine Helpers	..	2	..	..	2	..	16	5	..	..	..	3	..	..	..
Molding Machine Trainees	..	2	..	..	..	..	..	..	..	..	..	..	1	7	..
Light Coremakers— male	..	2	..	7	4	1	7	..	10	5	6	3	1	4	4
Light Coremakers— male, helpers	..	..	..	..	2	..	5	..	2	2	..	2	..	..	..
Light Coremakers— male, trainees ...	..	..	..	..	..	..	4	..	..	..	..	2	1	..	..
Heavy Coremakers— male	12	3	..	..	..	..	..	20	2	..	..	3	..	..	..
Heavy Coremakers— male, helpers	..	1	..	..	..	..	..	8	1	..	..	..	..	..	..
Heavy Coremakers— male, trainees ...	..	1	..	..	..	..	..	2	..	..	..	..	..	..	..
Coremakers, female ..	..	..	..	..	7	..	..	..	..	..	..	..	..	..	..
Cupola Tenders	..	1	2	1	..	1	1	4	2	3	3	2	1	1	3
Air Furnace Tenders.	12	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Traveling Crane Operators	25	..	1	..	3	..	5	1	..	..	..	1	..	..	..
Chippers	55	..	2	6	4	1	18	26	1	2	2	6	..	2	1
Grinders	7	..	..	2	8	1	12	..	4	3	..	1	2	4	3
Sand Blastmen	2	2	1	1	3	..	4	..	1	1	..	1	4	..	..
Inside Common Laborers	55	12	..	30	16	..	42	26	16	8	4	7	18	18	5
TOTAL	231	92	19	99	64	11	143	196	64	49	34	68	67	54	63

X C

TY-THREE FOUNDRIES ADJACENT TO PHILADELPHIA, DECEMBER, 1923

6	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*Total*
3	3	8	13	18	4	2	4	8	7	7	8	21	..	12	6	39	5	402
.	..	..	1	2	..	..	..	2	4	4	5	21	..	..	2	24	..	135
0	..	2	9	3	..	..	..	2	2	2	..	3	..	1	..	9	1	83
.	..	..	16	..	3	8	..	..	30	30	..	..	..	..	..	25	..	142
.	..	..	..	..	..	..	..	..	15	15	..	..	..	..	..	19	..	66
.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	11	..	12
.	..	..	17	..	..	..	..	..	..	..	..	..	..	..	..	..	..	23
.	..	..	12	..	..	..	..	..	..	..	..	..	..	..	..	..	..	18
.	..	..	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4
3	4	6	2	10	7	..	3	5	..	..	..	4	2	5	3	4	3	154
.	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	7
3	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	30
.	..	..	2	..	..	..	..	1	2	2	..	..	23	..	..	3	10	109
.	..	..	..	..	..	..	..	..	2	2	..	..	..	..	..	..	..	32
.	..	..	2	..	..	..	..	..	..	..	..	..	2	..	..	..	..	14
1	1	..	4	2	..	1	1	3	3	3	2	17	4	1	2	30	1	130
.	..	..	..	..	..	..	1	..	..	..	..	2	..	..	1	..	..	17
5	..	2	1	2	..	..	..	2	..	..	..	..	2	..	1	3	..	25
.	..	..	11	..	6	3	..	..	9	9	..	..	..	..	..	15	..	93
.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	13
.	..	..	..	..	..	..	..	..	3	3	..	..	..	..	..	..	..	9
.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	7
1	1	3	4	..	2	3	1	2	..	..	3	2	3	2	1	3	1	57
.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	14
.	..	..	6	..	1	1	..	..	17	14	1	5	..	..	..	16	..	97
.	2	..	3	4	10	2	..	3	31	30	6	16	..	..	2	26	..	261
9	1	2	..	2	..	1	3	1	3	2	..	..	4	5	2	1	5	88
1	..	..	1	1	..	..	..	1	3	2	..	..	1	2	..	1	3	36
0	..	2	47	3	5	7	..	4	8	16	2	29	10	5	6	52	5	468
0	12	25	155	49	39	28	13	34	139	141	27	120	51	33	26	286	34	2546

APPENDIX D

Glossary of Foundry Terms

Air furnace—A reverberatory iron melting furnace used principally in the malleable iron industry.

Bench—A table, usually only of frame work, at which small castings are made.

Binder—Material mixed with sand to cause the particles of sand to adhere to each other. Used in the manufacture of cores to enable them to retain their shape after baking operation. Common binders are wheat flour, rye meal, powdered rosin, and linseed oil.

Cope—The upper part or half of a mold.

Core—A body of sand placed in the mold to form a hole or pocket. May be made of either green or dry sand.

Cutting sand—Aerating and mixing sand by means of shoveling.

Drag—The bottom part or half of a mold.

Drawing—Removing the pattern from the mold.

Dry sand—Sand that has been baked in an oven after its formation into a mold.

Flask—A metal or wooden container, consisting of four sides without top or bottom; in it sand is molded about a pattern.

Flux—A basic material, usually limestone, put into melting furnace to hasten reduction and remove impurities.

Gagger—Rod put into a mold to support pendent bodies of sand.

Gate—A hole in the cope part of the mold into which the iron is poured.

Green sand—Molding sand that has not been baked.

Jarring machine—A molding machine which packs the sand in the flask by lifting the flask and dropping it on a table.

Loam—A term applied to mixtures of clay, sand, and humus, used in loam molding.

Main floor—That part of foundry where heavy castings are made.

Malleable iron—A hard, tough, brittle, white iron.

Riser—A hole at the highest point in the cope part of the mold. The metal poured in through the gate flows into the body of the mold and up into the riser, indicating the height of the metal.

Roll-over machine—A machine for turning over the flask prior to withdrawing the pattern.

Roll-over and draw machine—A machine which rolls over the flask and withdraws the pattern.

Sash weight shop—A foundry which manufactures sash weights which are made of very hard iron unsuited for articles to be machined.

Shaking out—The operation of removing the casting from the sand after it has solidified.

Side floor—A bay in the foundry where light work is done with the aid of a hand crane.

Split pattern machine—A squeezer type of molding machine for molding split patterns which have been split in order to provide a plane surface. Especially adapted for patterns, both sections of which are symmetrical.

Squeezer—A molding machine which performs the sand packing operation by applying pressure on the surface of the sand.

Stripping plate machine—A molding machine which withdraws the pattern through an opening in a plate. Opening is shaped like the pattern to eliminate damage in drawing. Used for patterns that are hard to draw.

Tempering sand—Mixing water with sand to moisten clay in it, thus making it adhesive.

Vent—Channel in cope part of mold to permit escape of gases formed when iron is poured.

Weighting—Placing of a weight on the finished mold to prevent the cope from rising from the drag due to the pressure of the molten metal when poured.

APPENDIX E

Growth in Number of Machine Molders

The following table presented by M. L. Stecker in an article, "The Founders, the Molders, and the Molding Machine," in the *Quarterly Journal of Economics*, February, 1918, pp. 305-308, shows the relation of machine molders and skilled bench and floor to total molding force in the foundries of the National Founders' Association in the years indicated. The figures were furnished by the National Founders' Association and covered, for 1910, 13.4% of all those in the country working at molding. Stecker points out that the tables should be interpreted in the light of the fact that 85% of the members of the Association ran open shops and that the trend might have been different in those foundries where the Union was in control.

Year	*Machine Operators Per Cent of Total Molders*	*Skilled Bench and Floor Molders Per Cent of Total Molders*	*Specialty Molders Per Cent of Total Molders*
1900	9.4	75.7	..
1905	14.4	63.0	9.5
1910	19.4	54.3	15.0
1913	22.8	51.8	15.6

APPENDIX F

DEATH RATES PER 1,000. ALL CAUSES OF DEATH. WHITE MALES IN THE INDUSTRIAL DEPARTMENT METROPOLITAN LIFE INSURANCE CO. BY AGE PERIODS—1922

All ages—one and over	8.24
1 to 4	7.79
5 to 9	2.73
10 to 14	2.11
15 to 19	3.12
20 to 24	4.03
25 to 34	5.23
25 to 29	4.63
30 to 34	5.95
35 to 44	8.94
35 to 39	7.91
40 to 44	10.19
45 to 54	15.92
45 to 49	13.58
50 to 54	18.63
55 to 64	31.19
55 to 59	25.63
60 to 64	38.07
65 to 74	67.35
65 to 69	57.77
70 to 74	86.33
75 and over	128.16

APPENDIX G

The following table shows the death rate per thousand among iron molders. It is not possible to reveal the source of the data, which are, however, authentic.

DEATH RATE OF IRON MOLDERS

Age of Decedents	*Death Rate per 1000*
10 years and over	10.707
10 to 13 years	6.690
20 to 24 years	4.112
20 to 44 years	6.033
20 to 64 years	8.707
25 to 44 years	6.334
45 years and over	24.871
45 to 64 years	17.169
65 years and over	136.364

APPENDIX H

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APPENDIX J

Standard Form of Interview with Foundrymen

Name of firm.....Date.....

Person interviewed.....Position.....

Total annual capacity.....Present production.....

Nature of Work
(Percentage of total poundage)

Jobbing — Light (.....#) ..... / Heavy (.....#) ..... — Floor — Green sand..... / Dry sand..... / Loam .....

Machinery .....Bench .....

Stove .....Machine .....

Amount and nature of repetition work.....

.....

Type of Machinery

.....

.....

.....

History of installation .....

.....

Training Program

Type of Training: Apprenticeship, Definite Upgrading, Specialized, Pick-up .....

.....

.....

Length of course.....Training given by.....

Order in which classes of work are taken up.....

.....

Class room instruction: Shop arithmetic.....

Blue print reading.....

Shop practice .....

Do you supply written material.....

.....

Correspondence courses .....

System of pay (flat and per cent rates, schedule of advances).....

.....

.....

Sources of supply .....

.....

Per cent foreign born...Per cent native whites...Per cent Negroes...

Age range of trainees.....Education .....

Turnover among trainees.....Per cent retained after training.....

Nature of duties of trainees.....

.....

.....

.....

Attitude of skilled men toward trainees and training.....

.....

Proper ratio of apprentices to journeymen.....

Trained Personnel

System of recruiting trained workers (advertising, M. M. A., Gate, Employees, etc.) .....

.....

Bench.....Floor .....

Machine.....Coremakers .....

Nativity of workers: Bench.....Machine.....

Floor.....Coremakers .....

Duties of employees: Bench.....

Floor .....

Machine .....

Coremakers .....

Distinction between helper and journeyman.....

.....

Turnover data available.....

No. of foremen.....Assistant foremen.....

Is skilled all-around molder necessary and to what extent?.....

.....

.....

.....

Physical Conditions

Light .....

Heat .....

Ventilation .....

Sanitation .....

.....

General Philosophy on Training

By public schools .....

.....

.....

By central training plant.....

.....

.....

By course within plant .....

.....

.....

Notations

.....

.....